PERFORMANCE OF WATER HYACINTH FOR REMOVAL OF ORGANIC AND INORGANIC POLLUTANTS FROM INDUSTRIAL WASTEWATER

PAVITHRA A/P ENGITARAVANAN

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree in Bachelors of Civil Engineering.

_____

(Supervisor's Signature)

Full Name : DR MIR SUJAUL ISLAM

Position : SENIOR LECTERUR, FACULTY OF CIVIL ENGINEERING AND EARTH RESOURCES, UNIVERSITI MALAYSIA PAHANG

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : PAVITHRA A/P ENGITARAVANAN

ID Number : AA15253

Date :

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PAVITHRA A/P ENGITARAVANAN

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DEDICATION

I would like to dedicate my gratitude to the almighty, parents, siblings, supervisor and my fellow friends for the encouragement given throughout the completion of this research project.

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ABSTRACT

Water quality deterioration is one of the major concerns in the world. Rapid industrial and commercial developments are causing tremendous pressure on the water resources. Speedy developments in the industrial sector at Gebeng area threaten the water quality of its two rivers and deteriorating the environmental condition of the areas. Phytoremediation can be defined as the efficient use of plants to remove, detoxify or immobilise environmental contaminants in a growth matrix through the natural biological, chemical or physical activities and processes of the plants. The objectives of this research was to identity the level of organic and inorganic pollutant in industrial wastewater for baseline information and to determine the effectiveness of water hyacinth plant to remove the pollutants contains in wastewater. In this study, the tests and experiments was held in the field level for in-situ data and in the Environmental Laboratory of Universiti Malaysia Pahang for ex-situ data. The wastewater was collected from the study area and was analysed to collect the water quality data. The industrial wastewater which has been collected was poured into the three different containers. All the three containers was treated with water hyacinth with different percentage of wastewater sample. The experiment was carried out for one month duration with average of 3 measurements for each percentage. The parameters that was tested are pH, DO, temperature, turbidity, BOD, COD, TSS, Ammoniacal Nitrogen, Chromium, Copper and Lead. The highest removal efficiency of BOD, COD, TSS, Ammoniacal Nitrogen, Turbidity, Chromium, Copper and Lead was 73.3%, 82.1%, 70.8%, 66.4%, 67.8%, 68.9%, 67.1% and 65.9%. So, 100 % sample with water hyacinth is more efficient compare to 70% sample with water hyacinth and 50% sample with water hyacinth on removing organic and inorganic pollutants in industrial wastewater. Hence, the results proved that phytoremediation using water hyacinth plant is suitable and effective to treat industrial wastewater.

ABSTRAK

Kemerosotan kualiti air adalah salah satu daripada kebimbangan utama di dunia. Perkembangan industri yang pesat adalah salah satu punca kemerosotan kualiti air yang kerap berlaku di Malaysia. Perkembangan yang pesat dalam sektor industri di Gebeng mengancam kualiti air sungai dan keadaan alam sekitar di kawasan tersebut. Fitoremediasi merupakan salah satu cara yang sesuai untuk menangani masalah pencemaran air. Teknologi ini menggunakan tumbuhan untuk menyerap bahan tercemar yang terdapat dalam air yang tercemar. *Water hyacinth* digunakan untuk merawat sampel air yang tercemar dari Gebeng. Objektif kajian ini adalah untuk mengenal pasti tahap pencemaran organik dan bukan organik di dalam air sisa industri sebagai maklumat asas dan untuk menentukan keberkesanan tumbuhan *Water hyacinth* untuk membuang bahan cemar yang terkandung di dalam air sisa. Dalam kajian ini, ujian dan eksperimen telah diadakan di kawasan kajian bagi data in-situ dan di Makmal Alam Sekitar, Universiti Malaysia Pahang untuk data ex-situ. Air sisa dan air suling dikumpulkan dari kawasan kajian dan dianalisis untuk mendapatkan data kualiti air. Air sisa perindustrian yang telah dikumpulkan telah dicurahkan ke dalam tiga bekas yang berbeza. Kesemua tiga bekas dicampur dengan air suling mengikut peratus yang berbeza. Eksperimen telah dijalankan selama sebulan tempoh dengan purata tiga ukuran bagi setiap peratus air sampel. Parameter yang telah diuji adalah *pH, DO*, suhu, kekeruhan, *BOD, COD, TSS, Ammoniacal Nitrogen, Chromium, Copper* dan *Lead*. Kecekapan penyingkiran tertinggi *BOD, COD, TSS, Ammoniacal Nitrogen,* kekeruhan, *Chromium, Copper* dan *Lead* adalah 73.3%, 82.1%, 70.8%, 66.4%, 67.8%, 68.9%, 67.1% and 65.9%. Jadi, 100% sampel dengan *water hyacinth* adalah lebih berkesan berbanding dengan 70% sampel dengan *water hyacinth* dan sampel 50% dengan *water hyacinth* untuk mengurangkan bahan pencemar organik dan bukan organik di dalam air sisa industri. Oleh itu, keputusan daripada eksperimen membuktikan bahawa Fitoremediasi menggunakan tumbuhan *water hyacinth* adalah sesuai dan berkesan untuk merawat air sisa industri.

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
TSS	Total Suspended Solid
Cr	Chromium
Cu	Copper
Pb	Lead
RE	Removal Efficiency
WH1	100% sample water with water hyacinth
WH2	70% sample water with water hyacinth
WH3	50% sample water with water hyacinth

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Water is one of the important needs in human living. The sources are consisting of surface water and groundwater. In natural aquatic ecosystem metals occur in low concentrations normally at the Nano gram to microgram per litre level. In recent time, however the occurrence of metals in excess of natural loads have become a problem of increasing concern. This situation thus arises as a result of the rapid growth in population, increased urbanization, expansion of industrial activities, exploration and exploitation of natural resources, extension of irrigation and other modern environmental regulation. The concentrations of heavy metals in water may vary considerably depending an annual and seasonal fluctuation. At low levels, some heavy metals such as copper, zinc and iron are essential for enzymatic activities and many biological processes while other metals such as cadmium, mercury and lead have no known essential role in living organisms and are toxic at even low concentrations.

As Malaysia is fast becoming an industrial country, many of the rivers have become polluted due to the many wastes that have been poured out into the rivers (Afroz et al., 2014). Gebeng one of the industrial clusters in Pahang, Malaysia consists of a large number of petrochemicals, chemicals, metal builders, polymer and other industries. Petrochemical factories produces large amount of wastewater daily. The township is mixed development which comprises commercial and residential unit, boasting of wide range of amenities and facilities. The untreated wastewater consists of heavy metals and other contaminants are being discharged into water system in Gebeng which caused the ecosystem to degrade at fast rate. The extinction of species happens due to unbalanced ecology and toxic which causes economic loss. Industrial wastewater can be determined

as the water effluents from industrial sources that may contain hundreds to thousands of chemicals, but only a few are responsible for aquatic toxicity (Loan et al., 2014).

This study focused on the technology that being applied in order to treat the water pollution problem which is caused by the industrial wastewater. There are many methods in order to treat the industrial wastewater depending on the suitability, one of them is phytoremediation. The phytoremediation of metals is a cost-effective green technology based on the use of metal-accumulating plants to remove toxic metals, including radionuclide, from soil and water. Phytoremediation takes advantage of the fact that a living plant can be considered a solar-driven pump, which can extract and concentrate particular elements from the environment. This phytoremediation technology is suitable to be applied in treating the industrial wastewater since it is the emerging clean up technology for contaminated soils, groundwater and wastewater that is both low-tech and low cost.

Phytoremediation is employed to describe the uptake mechanism of both organic and inorganic contaminants. For organic contaminants, it involves phytostabilization, rhizodegradation, rhizofilteration, phytodegradation and phytovolatilization. These mechanisms are related to organic contaminant property are not able to be absorbed into plant tissue and for inorganic, mechanism which can be involved are phytostabilization, rhizofiltration, phytoaccumulation and phytovolatilization. Phytodegradation occurs when metabolic processes with the plant breakdown the organic chemical while phytoaccumulation occurs when typically inorganic compounds are absorbed into the plants system (Taiwo et al., 2015). Among the different remediation techniques, phytoremediation has been proven to have the most effective approach to alleviate the environmental problems associated with contamination. It is eco –friendly, cost effective, not harmful, and not expensive and it allows the treatment of the impacted water without any interruption.

1.2 PROBLEM STATEMENT

Water quality deterioration is one of the major concerns of the world. Rapid industrial and commercial developments are causing tremendous pressure on the water

resources. Speedy developments in the industrial sector at Gebeng threaten the water quality of its two rivers and deteriorating the environmental condition of the areas. The random discharge of wastewater and effluents from industries, sewerage treatment plants along the river catchments are impairing the water quality. The Gebeng area is situated in the neck of the South China Sea and the adjacent two rivers flows fall to the sea. The typical tides of the sea cause intrusion of seawater into these two rivers and the water levels usually rise from 0.5 m to 2.5 m and it is likely to be tidal up to 10 km upstream. As a result the industrial effluents that are dumped from the industrial estate can go upward and cause environmental pollution all over the area (Moyo et al., 2013).

Environmental degradation has started here since the inception of the industrialisation in early 1970's when the deforestation and reclaiming was started using fill, quarried from the nearby hilly areas. Due to deforestation and reclamation, the soil of the area has also been contaminated. The process of contamination has been accelerated with the discharge of industrial effluents. Moreover, contamination of soil is a common problem in the surrounding area of any industrial estate like Gebeng. The water pollution and contaminated soil can hamper the regular livelihood of the residential area. By using the polluted water may create various water born disease and other disasters. Therefore, it is essential to assess the water quality, find out the sources of pollution and the water quality trend that can generate important information for the authority concerned or policy makers to take proper action for better management.

Phytoremediation can be defined as the efficient use of plants to remove, detoxify or immobilise environmental contaminants in a growth matrix through the natural biological, chemical or physical activities and processes of the plants. Plants are unique organisms equipped with remarkable metabolic and absorption capabilities, as well as transport systems that can take up nutrients or contaminants selectively from the growth matrix, soil or water. Phytoremediation involves growing plants in a contaminated matrix, for a required growth period, to remove contaminants from the matrix, or facilitate immobilisation or degradation of the pollutants. The plants can be subsequently harvested, processed and disposed.

Plants have evolved a great diversity of genetic adaptations to handle the accumulated pollutants that occur in the environment. Growing and, in some cases,

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